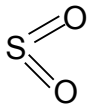
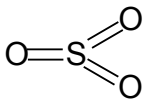
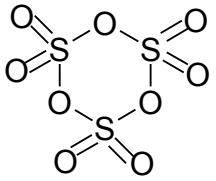
1998/99 õa keemiaolümpiaadi lõppvooru ülesannete lahendused
9. klass

1. **a)**

i) 

ii) 

iii) 

b) **i)** S_3O_9

ii) $M(S_3O_9) = 3 \cdot 32\ g/mol + 9 \cdot 16\ g/mol = 24\underline{0}\ g/mol$

c) **i)** $m(S_3O_3) = 3 \cdot 32\ amü + 3 \cdot 16\ amü = 144\ amü$

ii) $\frac{9 \cdot 16}{3 \cdot 32} = 1{,}5$

iii) $\frac{80}{240} = \frac{1}{3}$

d) $m(S_3O_9) = 24\underline{0}\ g/mol \cdot \frac{1\ mol}{6{,}02 \cdot 10^{23}\ molekul} = 3{,}99 \cdot 10^{22}\ g/molekul$

e) **i)** $S_3O_9 + 3H_2O = 3H_2SO_4$

$n(H_2O) = 27\underline{0}\ g \cdot \frac{1\ mol}{18\ g} = 15\ mol$

Vett on suures ülehulgas

ii) $\%(H_2SO_4) = \frac{\frac{3}{1} \cdot 1\ mol \cdot 98{,}1\ g/mol}{1\ mol \cdot 240\ g/mol + 270\ g} \cdot 100 = 57{,}7$

2. **a)** **i)** $\Sigma(n) = 5{,}1\ m^3 \cdot \frac{1000\ dm^3}{1\ m^3} \cdot \frac{1\ mol}{15\ dm^3} = 340\ mol$

ii) $n(O_2) = 340\ mol \cdot 0{,}15 = 51\ mol$

b) **i)** $2H_2 + O_2 = 2H_2O$

ii) $CH_4 + 2O_2 = CO_2 + 2H_2O$

iii) $2H_2S + 3O_2 = 2H_2O + 2SO_2$

c) **i)** $n'(O_2) = \frac{1}{2} \cdot 340\ mol \cdot 0{,}25 - 51\ mol = -9\ mol$

ii) $n'(O_2) = \frac{2}{1} \cdot 340\ mol \cdot 0{,}30 - 51\ mol = 153\ mol$

iii) $n'(O_2) = \frac{3}{2} \cdot 340\ mol \cdot 0{,}20 - 51\ mol = 51\ mol$

d) i) $\Delta H = 340\ mol \cdot 0{,}25 \cdot (-240\ kJ/mol) = -2{,}0 \cdot 10^4\ kJ$

ii) $\Delta H = 340 \cdot 0{,}30 \cdot (-800\ kJ/mol) = -8{,}2 \cdot 10^4\ kJ$

iii) $\Delta H = 340\ mol \cdot 0{,}20 \cdot (-520\ kJ/mol) = -3{,}5 \cdot 10^4\ kJ$

3. **a)** $2NaHCO_3 \xrightarrow{t^o} Na_2CO_3 + CO_2\uparrow + H_2O$

b) $m(Na_2CO_3) = \frac{1}{2} \cdot 0{,}500\ mol \cdot 106\ g/mol = 26{,}5\ g$

$m(H_2O) = 25\underline{0}\ cm^3 \cdot 0{,}958\ g/cm^3 = 239{,}5\ g$

$m(H_2O') = \frac{1}{2} \cdot 0{,}500\ mol \cdot 18{,}0\ g/mol = 4{,}5\ g$

$m(\Sigma H_2O) = 239{,}5\ g + 4{,}5\ g = 244\ g$

$$\mathbf{\%(Na_2CO_3)} = \frac{26{,}5\ g}{244\ g + 26{,}5\ g} \cdot 100 = \mathbf{9{,}80}$$

c) $\mathbf{V(H_2O)} = 244\ g \cdot \frac{1\ cm^3}{1\ g} = \mathbf{244\ cm^3}$

4. **a)** 1) $CaO + (H_2O) + CO_2 = (H_2O) + CaCO_3$

A – kaltsiumkarbonaat

2) $CaO + H_2O + 2CO_2(liig) = Ca(HCO_3)_2$

B – kaltsiumvesinikkarbonaat

3) $Fe + 2HCl(liig) = FeCl_2 + H_2$

C – raud(II)kloriid

4) $Fe(liig) + 2HCl = FeCl_2 + H_2$

D – raud(II)kloriid

5) $2NaOH(lahus) + CO_2 = Na_2CO_3 + H_2O$

E – naatriumkarbonaat

6) $NaOH(lahus) + CO_2(liig) = NaHCO_3$

F – naatriumvesinikkarbonaat

7) $NH_3 + HCl(liig) = NH_4Cl$

G – ammooniumkloriid

8) $NH_3(liig) + HCl = NH_4Cl$

H – ammooniumkloriid

9) $3NaOH + AlCl_3 = Al(OH)_3 + 3NaCl$

I – alumiiniumhüdroksiid

10) $6NaOH + AlCl_3 = Na_3[Al(OH)_6] + 3NaCl$

J – naatriumaluminaat e naatriumheksahüdroksüaluminaat

b) 1') $CaCO_3 \xrightarrow{t^o} CaO + CO_2$

t^o

2') $Ca(HCO_3)_2 = CaO + H_2O + CO_2$

3' ja 4') $FeCl_2$ kuumutamisel ei lagune

5') Na_2CO_3 kuumutamisel ei lagune

t^o

6') $2NaHCO_3 = Na_2CO_3 + H_2O + CO_2$

t^o

7' ja 8') $NH_4Cl = NH_3 + HCl$

5. **a) i**) $HCl + NaOH = NaCl + H_2O$

ii) $HNO_3 + NaOH = NaNO_3 + H_2O$

iii) $H_2SO_4 + 2NaOH = Na_2SO_4 + 2H_2O$

b) i) $Na_2SO_4 + BaCl_2 = BaSO_4\downarrow + 2NaCl$

ii) $n(\mathbf{H_2SO_4}) = 2 \cdot 3{,}50 \cdot \frac{1\text{ mol}}{233\text{ g}} = \mathbf{0{,}0300\text{ mol}}$

c) i) $\mathbf{NaCl} + AgNO_3 = AgCl + H_2O$

ii) $\mathbf{n(HCl)} = 2 \cdot 5{,}00\text{ g} \cdot \frac{1\text{ mol}}{143\text{ g}} = \mathbf{0{,}0699\text{ mol}}$

d) H_2SO_4 ja HCl neutraliseerimiseks kulus

$n(NaOH) = 2 \cdot 0{,}0300 + 0{,}0699 = 0{,}130$ mol

$n(\Sigma NaOH) = 44{,}0\text{ g} \cdot 0{,}300 \cdot \frac{1\text{ mol}}{40{,}0\text{ g}} = 0{,}330$ mol

$\mathbf{n(HNO_3)} = \frac{1}{1} \cdot (0{,}330\text{ mol} - 0{,}130\text{ mol}) = \mathbf{0{,}200\text{ mol}}$

6. **a) i**) $n(HCl) = \frac{4}{5} V_a \cdot \frac{1\text{ mol}}{4{,}55\text{ dm}^3} = 0{,}1762\ V_a \cdot \frac{\text{mol}}{\text{dm}^3}$

Märkus: V_a = arvväärtus·dm^3

ii) $m(HCl) = 0{,}1758 V_a \cdot \frac{\text{mol}}{\text{dm}^3} \cdot 36{,}5\text{ g/mol} = 6{,}42 V_a \cdot \frac{\text{g}}{\text{dm}^3}$

b) $m(lahus) = m(H_2O) + m(HCl)$

$m(H_2O) = V_a \cdot 1000 \frac{\text{g}}{\text{dm}^3} = 1000 V_a \cdot \frac{\text{g}}{\text{dm}^3}$

$m(lahus) = 1000 V_a \cdot \frac{\text{g}}{\text{dm}^3} + 6{,}42 V_a \cdot \frac{\text{g}}{\text{dm}^3} = 1006{,}42 V_a \cdot \frac{\text{g}}{\text{dm}^3}$

c) $\mathbf{\%(HCl)} = \frac{6{,}42 V_a\ \text{g/dm}^3}{1006{,}42 V_a\ \text{g/dm}^3} \cdot 100 = \mathbf{0{,}638}$

Märkus: 4 ^oC juures ei ole vee tihedus neljast tüvenumbrist täpsem. Kui lahuse massi tüvenumbrite arv on ümardatud neljani, siis lugeda see õigeks. lahenduskäik lihtsustub, kui võtta anumate ruumalaks täpselt 1 dm^3.